Space Weather Technical Forecast

Issued on Monday, 19 September 2022 at 13:04 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing chance of M-flares/R1-R2 Radio Blackout. Chance of G1/Minor Storm late day 4 (22nd)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the past 24 hours, with a number of C-class flares. There are currently three numbered sunspots on the visible disc. The most notable is AR3102 Eai/Beta just west of the southern centre disc, although this remains a simple and relatively stable region. AR3100 Cso/Beta continues to simplify as it approaches the southwest limb. AR3104 Bxo/Beta was also numbered to the north of AR3100. There are three further unnumbered regions. This includes two small and indistinct regions, and also the returning region ex-AR3098 which is gradually becoming more visible as a new region on the southeast limb. No Earth-directed CMEs were observed in the last 24 hours

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, rose to peak around 550km/s by 18/2200 UTC, due to the arrival of the fast wind of CH23/-, before easing back to be slightly elevated at around 450km/s. Density remained at average to just below. The total interplanetary magnetic field (IMF), Bt has been mainly Moderate at 6-11nT with the north-south component Bz, ranging between -8nT and +9nT, but predominately positive (northward). The phi angle remained negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, remained slightly elevated above background levels over the 24 hours, but less than 2pfu. High energy electron flux (greater than 2 MeV) was generally at background to Moderate, with peak value 615 pfu at 18/1335 UTC. The associated 24 hour fluence remained below the Active (1e8 integrated pfu) threshold. Observed fluence at 19/0000UTC was 8.31e6 integrated pfu).

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low, but with a chance of rising again to Moderate with any notable flaring of AR3102. Flare risk may also increase as ex-3089 continues to rotate onto the disc

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are expected, although a CME which was expected to arrive late on the 18th or early 19th cannot be completely ruled out as giving a slight glancing impact day 1 (19th). Current slightly elevated solar winds are expected to continue ease towards background by day 3 (21st) with the next enhancement, from the fast wind of CH25/+ expected either late day 4 (22nd) or just after. Geomagnetic activity will be Quiet with isolated Unsettled spells, easing to be mainly Quiet. There is the potential for activity to increase to Active to G1/Minor Storm late on day 4 (22nd).

Energetic Particles / Solar Radiation: Current very slightly elevated high energy (greater than 10 MeV) proton flux observed by GOES-16 is expected to gradually ease through the period. The high energy electron flux (greater than 2MeV) is expected to rise day 1 (19th) onward due to recent fast wind and possible CME enhancement, perhaps reaching High at diurnal peak. The

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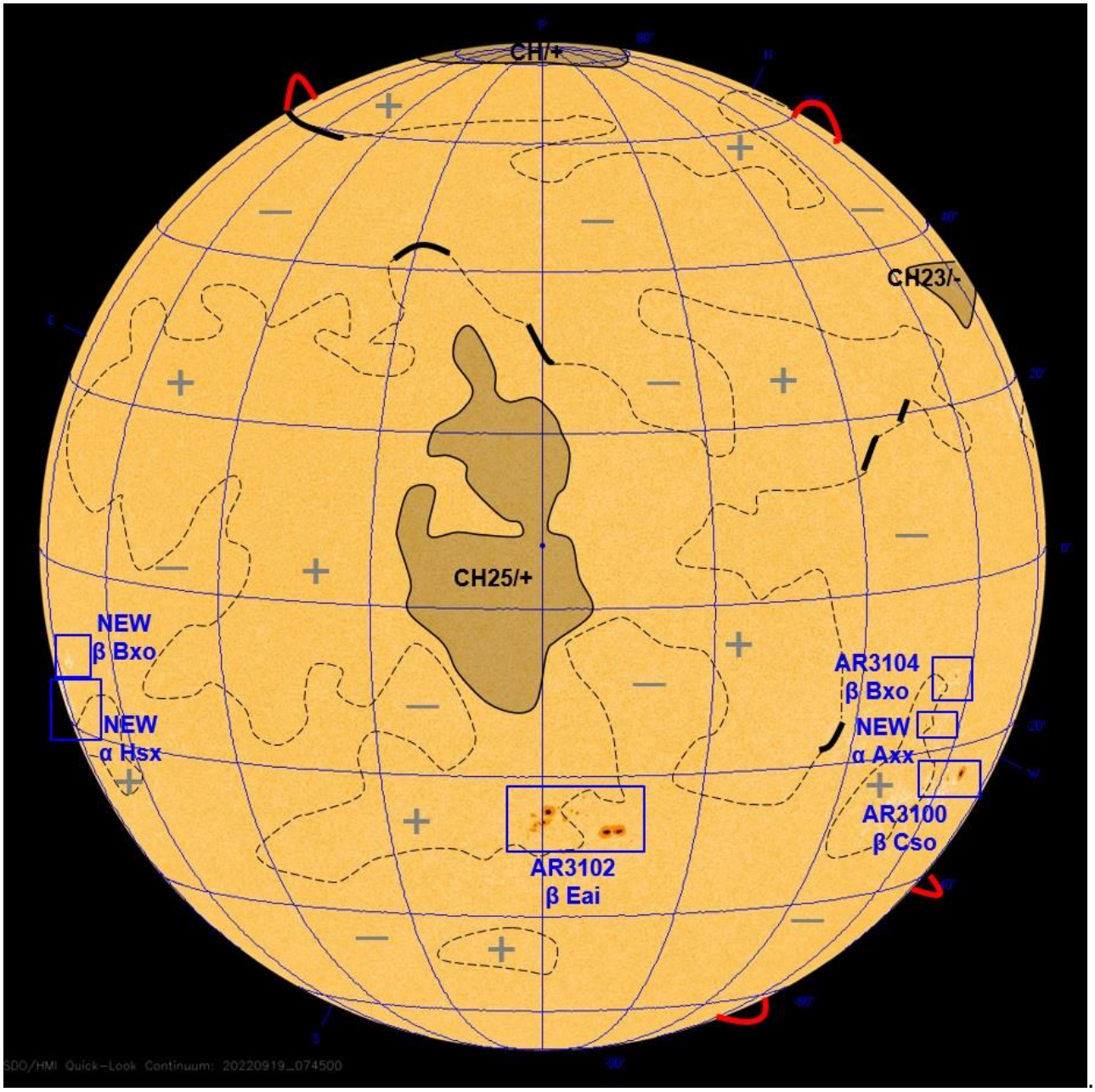
associated 24-hr fluence is expected to rise, but staying below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 19/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

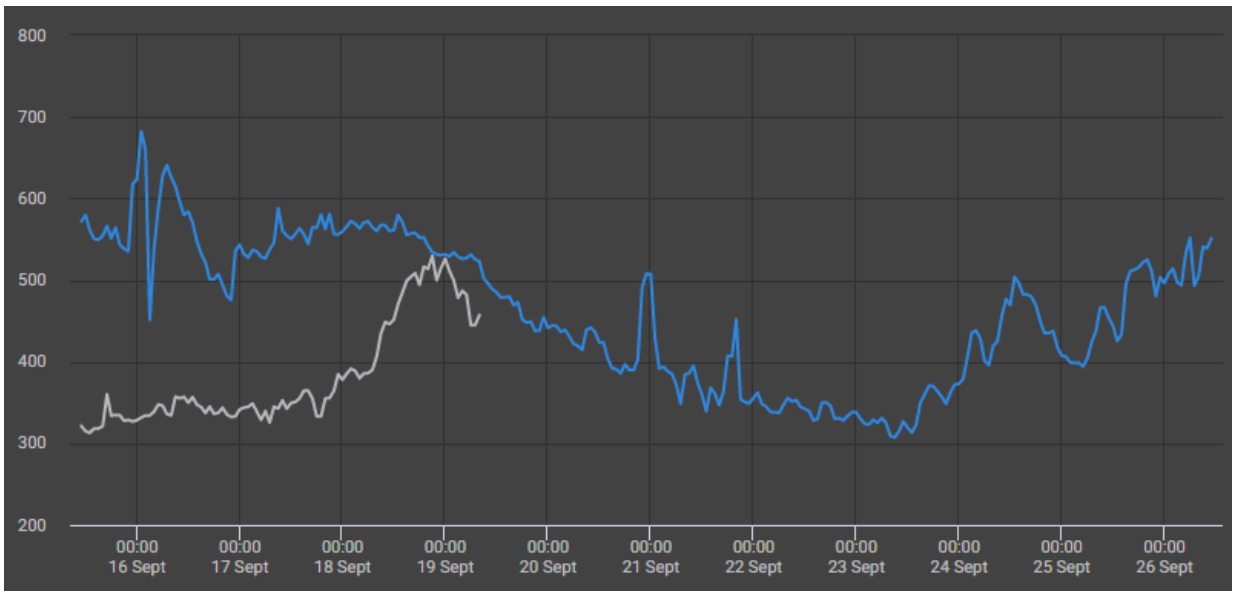
A CME, from a pair of filament eruptions late on the 15th and into the 16th, had a chance of giving a glancing interaction late on the 18th or early on the 19th (day 1). This is now considered to have likely missed although a glancing arrival remains possible later on day 1.

Earth is currently seeing the fast wind of negative polarity CH23 ease, with the current slightly elevated solar winds likely easing to background day 3 (21st). There is the potential for further strong enhancement around the end of day 4 (22nd) from the arrival of the fast wind of CH25/+, although this is more likely early on day 5 (23rd). This arrival is low confidence however, with this feature being new on this rotation, and also currently not being captured by MOSWOC enlil.

Geomagnetic activity will be Quiet with isolated Unsettled spells, easing to be mainly Quiet. There is the potential for activity to increase to Active to G1/Minor Storm late on day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar Wind Persistence Model



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Radio Blackouts - X-Ray Flares:

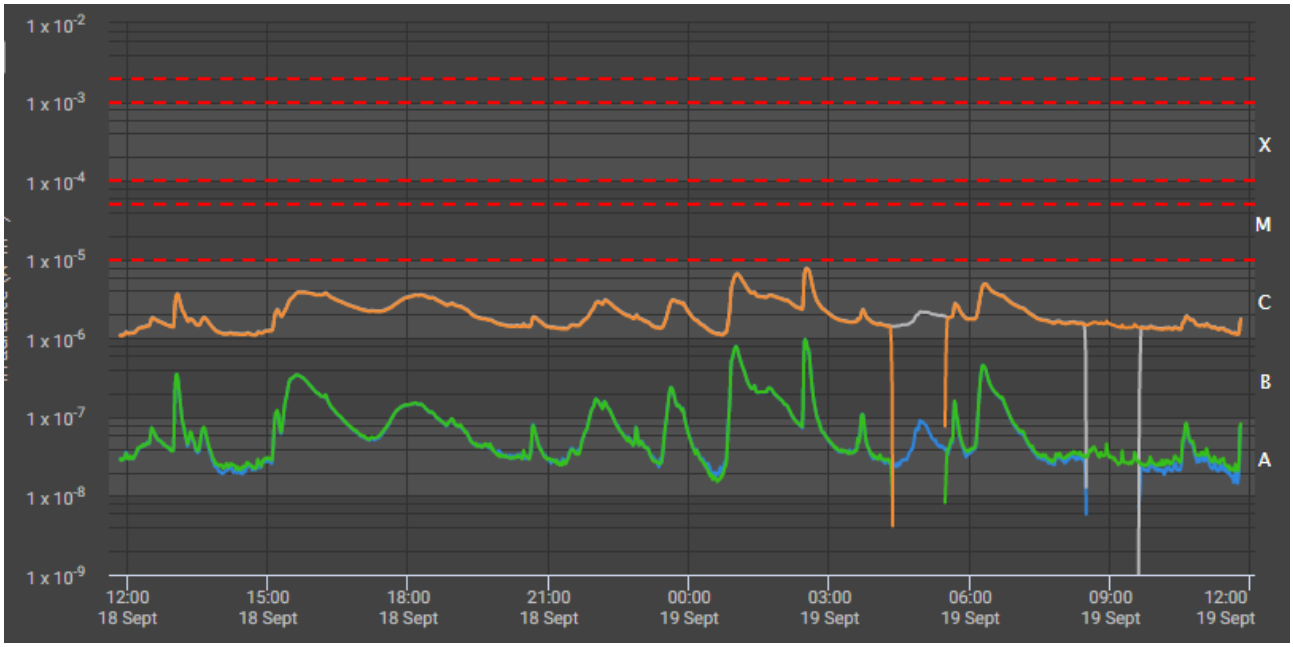
There are three numbered sunspot regions on the Earth-facing disc, and three unnumbered regions, resulting in generally Low activity with only C-class flaring observed.

The most prominent of the numbered regions is AR3102 Eai/Beta, which has now traversed across the centre disc and moved into the southwestern quadrant. This region has remained stable with no significant growth observed in the last 24 hours. The other two numbered regions are both smaller, and now approaching the southwest limb. The three unnumbered regions currently appear small and indistinct, however one of these is likely the forward most portion of ex-AR3098 which is associated with an area of notable magnetic looping on the southeast limb and been a source of flaring on the far side. More complexity has the potential to become apparent as this rotates onto this disc.

Solar activity is expected to remain Low, with a chance of isolated Moderate flaring, primarily from AR3102 or from the region returning on the southeast limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: GOES-16/17 X-ray Flux



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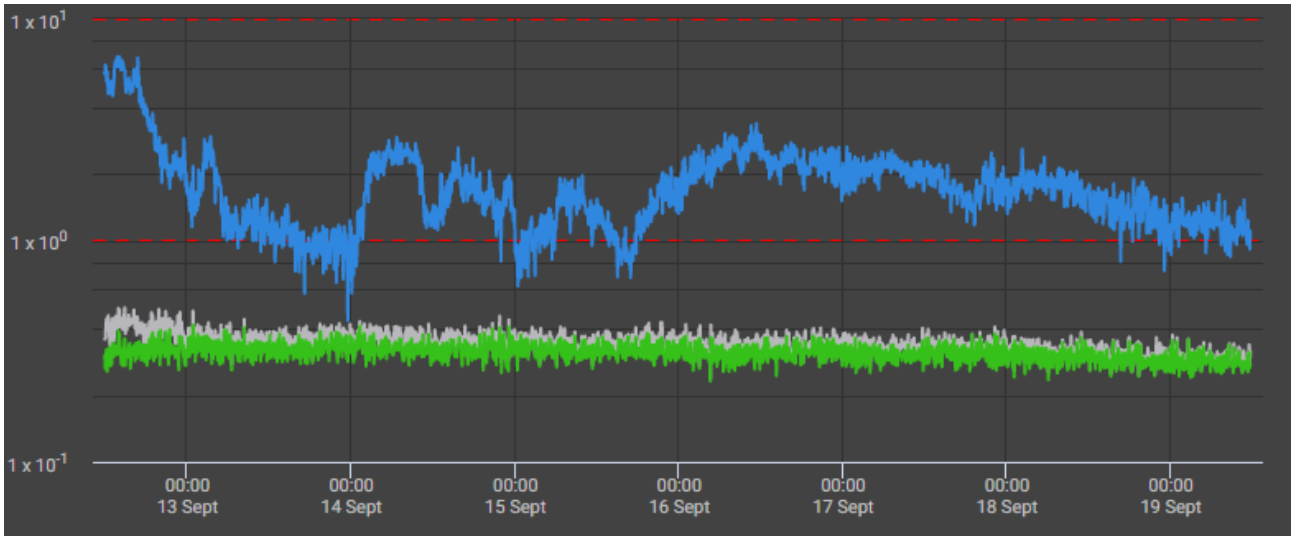
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) observed by GOES-16 remains slightly elevated at above background levels, but below the S1 level. These conditions have persisted for a number of days, with only a gradual decline towards background expected.

The most likely source of any subsequent enhancement would be from any activity from AR3102 which is now moving beyond the central southern disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-16 Proton Flux for the last 7 days.



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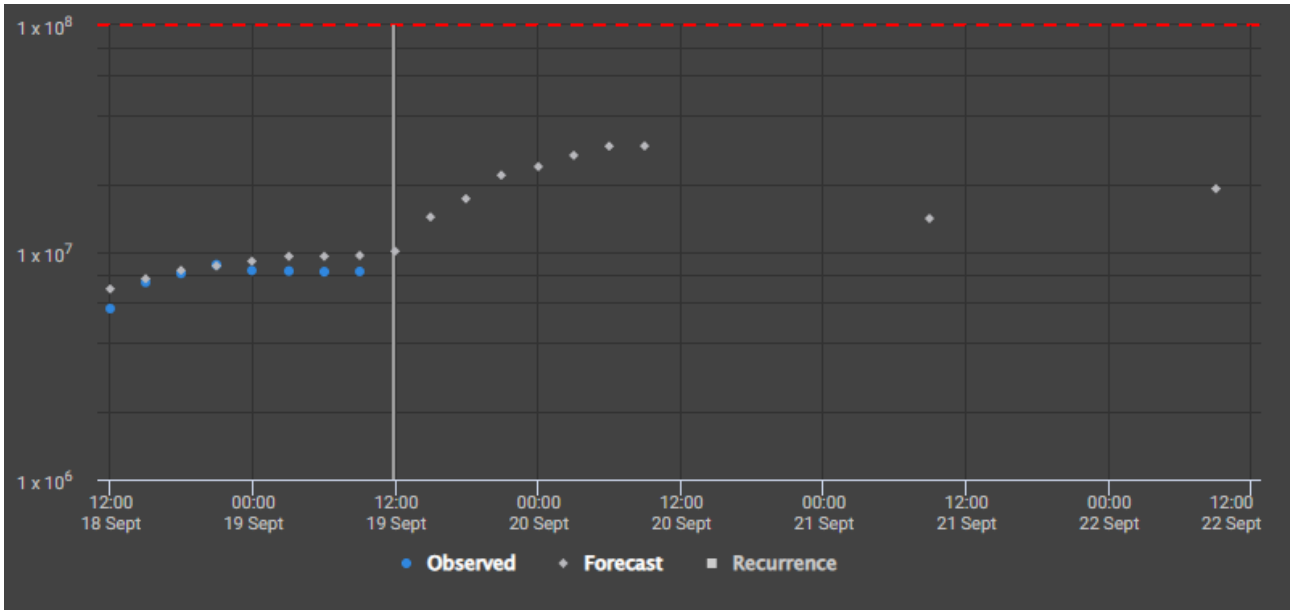
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as observed by GOES-16, is currently at Background to Moderate levels. Flux levels are expected to rise either on day 1 (19th) or potentially day 2 (20th). This may result in flux reaching High at diurnal maximum, but due to the relatively limited geomagnetic connection that has occurred to the fast wind of CH23, persistently flux is only a low risk.

The associated 24 hr fluence is expected to remain below the Active threshold, albeit with a rising trend in response to any elevated flux that occurs. REFM is also showing a slight increasing trend, and considered to be giving good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: GOES-16 >2MeV Electron Fluence with REFM.



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